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Multivariate monitoring of anaerobic co-digestion

On the way towards realisation of inline NIRS in large-scale agricultural biomass conversion facilities

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Title:

Multivariate monitoring of anaerobic co-digestion
- On the way towards realisation of inline NIRS in large-scale agricultural biomass conversion facilities

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Abstract

Anaerobic digestion processes for production of renewable energy in the form of biogas, and in the future hydrogen, are becoming increasingly important worldwide. Sustainable solutions for renewable energy production systems are given high political priority, amongst other things due to global warming and environmental concerns.

Anaerobic digestion applied in agriculture can simultaneously convert heterogeneous biomasses and wastes from the primary agricultural sector and from the bio processing industries, for instance food processing, pharma, and biofuel production, into valuable organic fertiliser and renewable energy.

Meanwhile, in order for the biogas sector to become a significant player in the energy supply chain, the anaerobic digestion process has to be controlled to a greater extent than what is implemented as state-of-the-art today. Through application of the philosophy behind Process Analytical Technology, well-known from the pharmaceutical sector, these objectives can be realised. NIRS and chemometrics are key technologies in this concern.

The feasibility studies summarised in this paper concerns at-line and on-line PAT monitoring of anaerobic digestion processes at several distinct scales. The aim was to investigate, whether changes in the chemical environment in the anaerobic digesters could be monitored by NIRS enabling biogas plant operators to respond to the process dynamics. Results show that several key intermediates suitable for control of the anaerobic digestion process can be quantified in a non-invasive manner by NIRS with good performance statistics. Especially this applies for the parameters total solids, volatile solids, ammonium, and volatile fatty acids.